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ABSTRACT

The push to integrate computer-assisted instruction in the curriculum is a phenomenon experienced by many teachers at all levels of instruction. However, questions remain unanswered regarding the effect that such technology will have on both the communicative instructional style of the teacher and on the learning process of the students. To initiate dialogue for the intent of exploring the complexity of the interaction of technology in schools, this qualitative case study explores the outcomes of computer-assisted instruction on the dynamics of the teaching-learning process in an introductory statistics course at a small private liberal arts university. Results from the data, based on two observations and interviews with students and their instructor, suggest several implications. First, computer-assisted instruction positively affects students' ability to comprehend statistical concepts. Secondly, the teacher's role is not perceived as an adjunct to computer-assisted instruction; rather it is viewed as an essential element of the teaching process. Thirdly, student pre-post attitudes about the subject of statistics remain unchanged, even with assistance from the computer program. Finally, the use of the computer-assisted program does affect the dynamics of the classroom in that students are more engaged with the subject matter and interact more freely with each other. Based on these findings, two recommendations for future research are suggested: an exploration of the effects of a computer-assisted program designated as a tutor versus one that is classified as a tool, and a further examination of pedagogical issues about the juxtaposition of instructor and computer-assisted instruction. (Contain 20 references.) (Author/RS)

Reflections from the Classroom on the Effects of Computer-Assisted Instruction on the Teaching-Learning Process

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Abstract

The push to integrate computer-assisted instruction in the curriculum is a phenomenon experienced by many teachers at all levels of instruction. However, questions remain unanswered regarding the effect that such technology will have on both the communicative instructional style of the teacher and on the learning process of the students. To initiate dialogue for the intent of exploring the complexity of the interaction of technology in our schools, this qualitative case study explores the outcomes of computer-assisted instruction on the dynamics of the teaching-learning process in an introductory statistics course at a small private liberal arts university. Results from the data based on two observations and interviews with students and their instructor suggest several implications. First, computer-assisted instruction positively affects students' ability to comprehend statistical concepts. Secondly, the teacher's role is not perceived as an adjunct to computer-assisted instruction; rather it is viewed as an essential element of the teaching process. Thirdly, student pre-post attitudes about the subject of statistics remain unchanged, even with assistance from the computer program. Finally, the use of the computer-assisted program does affect the dynamics of the classroom in that students are more engaged with the subject matter and interact more freely with each other. Based on these findings, two recommendations for future research are suggested: an exploration of the effects of a computer-assisted program designated as a tutor versus one that is classified as a tool, and a further examination of pedagogical issues about the juxtaposition of instructor and computer-assisted instruction.

Computer-Assisted Instruction

One of the most significant developments in the last decade is the widespread proliferation of computer hardware and software in education (Maddux, 1988). This proliferation has caused Steinberg (1991) to suggest that discussion about educational reform seems remiss without references to computer-assisted instruction. Maddux (1988) labels the trend to equate computer technology with educational reform as the "Everest Syndrome." Maddux (1988) states:

> Those who have succumbed to this syndrome believe that computers should be brought into educational settings simply because they are there. They believe further that mere exposure to computers will be beneficial to students, that computers ought to be used for any and all tasks for which software is available or imaginable, and that, if schools can only obtain a sufficient quantity of hardware and software, quality will take care of itself. (p. 5)

Maddux (1988) predicts that a belief in the Everest Syndrome will result in computer implementations that over-emphasize what hardware can be made to do, rather then what children using computers can be empowered to do. The result is that the importance of developing educational computing philosophy and theory is ignored (Maddux, 1988). Maddux (1988) posits that this lack of consideration of philosophy will lead to attitudes characterized by a motto that "everything should be computerized" (p. 7).

Maddux (1988) is not alone in his critical perspective on the value of computer technology in education. In an earlier, widely cited paper questioning the effect of computer technology on the student, Clark (1983) asserted that the medium is not the message. Clark (1983) argued that all the benefits attributed to previous research to computers could be explained by the teaching

methods they supported. He added that research should focus on specific teaching-learning methods, not on questions of media.

Yet a body of research does exist which posits that computer-assisted instruction does have a positive effect on student learning. Kulick (1994) states "at least a dozen separate meta-analyses have been conducted by researchers to answer questions about the effectiveness of computer-based instruction" (p. 11). Kulick (1994) believes that results from each of the meta-analyses from different independent research teams yielded similar conclusions regarding the effectiveness of computer-assisted instruction on student learning. Kulick (1994) lists the following as the major points emerging from these meta-analyses:

1. Students learn more in classes in which they receive computer-based instruction.
2. Students like their classes more when they receive computer help.
3. Students develop more positive attitudes toward computers when they receive help from them in school.
4. Computers do not, however, have positive effects in every area in which they were studied. There is evidence that subjects' responses to the subject matter do not significantly change, regardless of whether computer-assisted instruction was included. (p. 11)

Regarding these specific studies, Schofield (1995) argues that the quest to delineate a set of consequences regarding instructional computing will be futile since computer applications are varied from drill and practice programs to artificial intelligent tutors. She suggests that "expecting unvarying effects from such disparate uses of computer technology is unrealistic" (p. 190). To focus subsequent theory and research, Schofield (1995) emphasizes that research should center on

understanding the factors that influence the impact of the instructional use of computers on students, teachers, and classrooms. Schofield (1995) concludes that this focus will "...also make salient the fact that the influence of any particular technology on teachers, students, or others depends on a wide variety of contextual factors that shape the way it is used" (p. 191).

There is a growing body of literature that has begun to demonstrate the impact of using computers for instruction on a broad set of attitudinal and social outcomes (Schofield, Eurich-Fulcer, & Britt, 1994). For example, there is research suggesting that computer assisted instruction has a positive effect on student's attitudes towed themselves, learning, and school in general (Becker, 1987; Bialo & Sivin, 1990). Another theme that has emerged in several studies is the idea that the use of computers in the classroom increases student motivation and interest (Campbell, 1984; Ferrell, 1986).

Several studies also suggest that the use of various forms of computer assisted instruction have major implication for both teacher and student roles. The most common thread is the finding that use of instructional technology creates a less teacher-centered classroom. Consistent with this trend are studies that suggest the following: (a) when computers are used for instructional purposes, teachers become more comfortable with evidence of student expertise (Sandholtz, Rinstaff, & Dwyer, 1990); (b) teachers see themselves as facilitators of learning rather than authority figures whose job is it to impart knowledge (Bracey, 1988); and (c) students feel more in control and have more input into structuring classroom activities (Bialo & Sivin, 1990).

Schofield (1995) posits that even with the great variety of computer programs that exist, there is a need to discover if there are any effects of computer use that are relatively common. In order to seek the commonalties, a major research question is whether conclusions from earlier

studies, which predominately analyzed the effects of computer-assisted instruction in primary or secondary settings, would be replicated for a study situated in an institution of higher education. Will a computer-assisted tool influence students' attitudes about the subject matter? What will be the outcome of computer-assisted instruction on the learning process? How does the use of computer-assisted instruction affect the dynamics of the classroom both in terms of teaching methodology and student interaction? To explore these issues from a qualitative paradigm, this bounded, single-case study will utilize a variety of different qualitative methods. It will (a) describe observations about the dynamics of the functioning of the classroom based on the use of a computer-assisted program, and (b) compare and contrast data from semi-structured interviews with both students and the instructor on their reactions to the efficacy of computer-assisted instruction as a teaching aid.

Methods

Phenomenon

The phenomenon observed is the efficacy of a computer-assisted program as a teaching-learning tool. The study took place in an introductory statistics class at a small liberal arts college. It was bounded by time (two class periods) and by a single case (one group of students in a class). This study consists of two phases. First, the class was observed two different times. After the observation segment of this study was concluded, and the notes were transcribed, the second phase of this study began-the interview process. Three of the students and the instructor volunteered to comment about their reactions to the use of the computer-assisted tool.

Phase One-Observation

Participants. Ten students, seven females and three males and their male instructor in an introduction to statistics class were involved in this study. Although this class is designated as an introductory statistics class, its focus is on the application of the statistical method and not on the ability to compute the numbers with paper and pen. The instructor has chosen a textbook for this course titled Social Statistics by William Fox. This book is accompanied by a computer-assisted program titled MicroCase. Szabo (1995) labels programs similar to MicroCase as computer-assisted instruction (CAI) since they provide students with review and practice regarding a defined body of content, skills or instructional objectives.

The course was not advertised as including computer-assisted instruction so an assumption is made that many students were unaware of the computer-assisted program when they signed up for it. It is a forty contact hour course that meets twice a week. The course met in a computer lab on the campus of a small liberal arts university. Observation materials consisted of a gray legal pad and pen. At the first meeting, I introduced myself, the objective for qualitative research, the focus of my study, and asked for volunteers to be interviewed after the observation phase of the study was completed. Interview permission forms were distributed to the volunteers.

Data Collection. Data recording followed a running description pattern with an emphasis on describing behaviors both verbal and nonverbal exhibited by students and the instructor. Since I had arrived earlier before the class was scheduled to begin in order to observe students entering the classroom, I noted spatial elements such as room size, configuration, and general appearance. Once the students entered, I observed elements in a somewhat spatial configuration.

These elements consisted of where they sat, with whom, conversations they had with each other and their preparation patterns, both verbal and nonverbal, for the start of the class. Once the instructor appeared, I watched for the verbal and nonverbal reactions of the students to the chronology of the lesson and to the integration of the computer-assisted program in the lesson.

Regarding the instructor of this course, I noted how he reacted verbally and nonverbally to the students. I was particularly interested in the symbolic interchange of humor between instructor and students as the students struggled to master the material.

Phase Two-Interviews

Participants. The interviewees consist of three female students in an Introduction to Statistics class and their male instructor. The interviews with the students were held on Tuesday, October 27, at two o'clock in the afternoon in an office off campus where one of the students is employed. The meeting times were sequentially arranged with a fifteen-minute beak in between each interview. Each interview lasted fifteen minutes. The sessions were audiotaped, interview notes were recorded with an emphasis on nonverbal behaviors, and the tapes were later transcribed verbatim. Once the transcription process was completed, the contents of the audiotapes were erased. In this paper, the female students will be referred to as Student A, Student B, and Student C.

The interview with the instructor of the statistics course occurred at nine o'clock the morning of Thursday, October 29th. It took place in the instructor's office on the campus where he teaches the class. The interview lasted fifteen minutes and was audiotaped. The audiotape was later transcribed and the contents of the tape erased. In this paper, the professor for the course will be referred to as the Instructor.

Data collection. The interviews were organized according to a semi-structured interview pattern. The same sequence of questions was used for all of the students. A similar set of questions was used for the instructor. All interviews were conducted by the author of this report in a face-to face setting chosen by the participants. The interview questions were structured to evoke a wide variety of responses consisting of the following categories-informational questions about background information; interpretative questions that elicit attitudinal feelings; and hypothetical questions that probe for additional insight.

The objectives of the interviews with the students consisted of four key areas: pre-post attitudes of the students toward the subject of statistics, their reactions to the computer-assisted program as a teaching tool, their perception of the effects of the computer tool on the role of the instructor, and their response to the influence of computer-assisted instruction on the dynamics of the class. The questions were structured so that all of the students would first comment on their initial reactions to the subject matter followed by their responses to the computer program, and its effect on the role of the instructor and on the dynamics of the class.

The objectives of the interview with the instructor of the course were three-fold: to reveal his rationale for choosing a computer-assisted program as a teaching aid, to determine what his perception is regarding students' attitudes about the subject of statistics, and to discover what the instructor believes are the outcomes of computer-assisted instruction on the learning environment of the class.

The first set of questions probed for his past experience with teaching this course in a traditional lecture manner. Subsequent questions explored his reactions as to how computer-

assisted instruction influences the learning process of his students and his teaching methodology for the class.

Data Analysis

Coding Strategies-Observation

The written observations were listed in a running description pattern. Phrases were used versus sentences for descriptive observations. Quotations by students and instructor were written as sentences with the intent of recording as accurately as possible what had been stated.

Several codes were used to categorize the researcher's personal reactions to the events that transpired during the observations. OC was used for immediate personal reactions. WI represented further reflection about a possible working hypothesis. A question mark (?) suggested a need to pursue an issue further in the next contact, and the symbol of "2'nd" reflected uncertainty about the importance of an exchange that occurred during the observations.

After the observations from this study were completed, and reflection about the contents of the fieldnotes was conducted, the next step was to develop a set of major coding categories to organize the data that reflects the purpose of the research. Bogdan and Bilken (1998) recommend searching through the data from the fieldnotes for regularities and patterns as well as for topics covered by the data. Borrowing from Bogdan and Bilken's (1998) category examples as a base for creating a coding scheme including a wide range of activities, attitudes, and behaviors, the following five major category headings were used: setting/context, interaction patterns, strategy codes to encourage learning, students' perception of the class subject, and student involvement with the computer.

Procedures of Verification

Internal validity. The case study observation took place twice-same class, same setting, same students and instructor.

External validity. The attempt is made to provide a detailed description of the case study-a rich, thick description "so that anyone else interested in transferability has a base of information appropriate to the judgement" (Lincoln & Guba, 1985, pp. 125-125).

Coding Strategies-Interviews

The methodology to extract meaning from the data consists of a constant comparison method of analyzing the transcripts for similar or contrasting comments from each interview session. Subsequently, the frequency of a particular type of response was noted, and if there was more than one occurrence of a similar answer, it was recorded in the interviewer's summary sheet as a possible theme under the initial general headings of background information, attitudinal responses, and hypothetical suppositions. Using categorical aggregation (Creswell, 1998) as the rationale for developing categories, a coding system based on frequency data was designed.

Results

Observations

Setting/context. The setting/context category refers to codes under which the most general information on the topic, setting or subjects can be sorted. The environment of the classroom was not intimidating in that the room did not have bright or harsh lights. The color of the room was light gray and not distracting; the seven windows allowed for natural sunlight to creep in; and the white board and bulletin board next to the white board were blank-devoid of

any statistical markings which might have been perceived as daunting. Yet, when the students entered the classroom on both occasions, they chose to sit in the back rows of the room (see Figure 1).

Entry behaviors. There was little interaction between the students on the first occasion. They sat down at the computer terminal; some began to turn on the computer; others took out a newspaper to read. Since the classroom has twenty-one computer terminals, there was enough room for students to spread out if they chose to do so. For the first observation, the majority of the students did spread out and away from each other. This would suggest that the students did not really know each other yet or were not comfortable sitting next to each other.

On the second occasion, as noted earlier, the students still chose to sit in the back rows away from the front. However, there was marked difference in the interaction patterns between the first and second occasions. Students referred to each other by name. Three students hovered over the shoulder of one student as she was trying to figure out the answer to a problem. There was a greater sensation of synergy at this second occasion since conversations dealt with various aspects of the class: the topic of statistics, who had problems with a particular question, how overwhelmed they felt by the homework, and wondering how they could convince the teacher to give them an extra class period to work on a problem..

The instructor's entry behavior for the first observation also suggested a level of unfamiliarity with the students. He walked in without acknowledging the class; placed his teaching materials on the computer terminal located at the front left side of the room, shuffled some papers, cleared his throat, looked at the class for a few seconds to command attention, and began with a review of the topic from the last session. For the second observation, there was a

marked difference in the instructor's entry behavior. He still walked in and followed the same routine of placing his teaching materials on the computer terminal as indicated for the first observation. However, before he began class, he looked directly at students, walked closer to the first row of computer terminals to lessen the distance between himself and the students, and engaged in some "chit-chat" about the changing weather and the uncertainty about how to dress with three of the students who were to his immediate right. Five minutes into the class period had elapsed prior to the actual teaching of the class. This was in direct contrast to the first observation in which the instructor began the class as soon as the materials were laid out.

Process behaviors during class. In the first observation during class time, most of the students did not interact with each other. There was very little joking or side comments, except for five side comments heard from the three women who sat together in the back row, and the only interaction between the students and the instructor revolved on answering questions in relationship to the topic. For the second observation, students had picked up on the instructor's use of a term "instructor's personal bias" which basically meant that the instructor did not perceive that a particular methodology was credible. This was determined by the tone of the verbal reactions of the students in class: "Oh, so that's another one of your IPS's!" One student remarked, "Hey I wrote 'IPS' in my notes." There were numerous humorous comments mentioned a loud. "Imagine, who would want to spend one's life time figuring out that formula!" "Why couldn't they just devise formulas based on simple arithmetic." "Why would anyone want to be a number cruncher."

Strategy codes to encourage learning. Conscious ways in which the instructor uses the computer as a teaching tool are labeled strategy codes. The instructor lectured on the rationale

and procedure for using a particular statistical method for half the period for both observations. Students recorded the notes that were placed on the board. Once the lecture was completed, the computers were turned on, and the students were instructed on how to manipulate the data and to apply the statistical method. The instructor first demonstrated the steps by the use of the computer terminal at the front of the room which projected the images on the white board followed by the students attempting to model the process at their own terminals.

To encourage students, the instructor called on several students in class to explain the various steps of the statistical method. For the students who seemed to have difficulty following the procedures of the computer program, the instructor encouraged each student to turn to his/her neighbor for help and to not rely solely on the instructor for information.

Attitudes about the subject matter of the class. Students' attitudes about the subject consist of their verbal and nonverbal responses. Their initial attitudes contain comments made prior to class. For the first observation, little was said about the class. The nonverbal actions of not turning on the computers, reading a newspaper or sitting silently at the desk suggests a lack of engagement with the topic. During the class, students were quoted as saying, "Why do we need to learn this procedure?' "How is it ever going to help me?" Audible sighs were heard. Few questions were asked.

At the beginning of the second observation when the students entered the class, there was quite a bit of discussion on the topic. "Did you complete the last homework assignment?" "What groups did you use for your data?" "Explain again how you determine degrees of freedom?" "What's the difference again between interval/ratio and ordinal data?" There was a definite feeling of engagement even if there was a level of confusion about the topic. Students

would look over each other's assignments and turned on the computers to double-check the information from the computer program. During the time of the class when the students use the computer program, there seemed to be more of an urgency to open the program and there was more of a response from the students to model the steps of the statistical method for their classmates. There were less sighs and more "nodding of the head" type behaviors when the instructor would explain a point.

Student Computer Engagement. Computer engagement codes refer to actions- verbal and nonverbal-demonstrated by the students while using the computer-assisted program. Students at first seemed somewhat hesitant about using the computer program. Typical comments were: "How do you get into this program?" "How do you go from finding the data to applying the statistical measure?" Students were seen to shake their heads as they tried to access the correct statistical procedure. Other students would look away from the computer terminal and at their neighbors to see if anyone else was having difficulty. One student asked the teacher to stop talking so that he could catch up since he was having difficulty keeping up.

During the second observation, students seemed more confident with the computer program. There were far fewer "how to" questions and more why questions regarding a statistical model. When the instructor asked the students to work on a problem, the students seemed capable of getting to the spot in the program where they needed to be. Students seemed able to concentrate on task and to be less worried about how to perform the steps. Instead of looking at their neighbors, the students looked at the instructor when they were ready to perform the next step. There was a feeling of confidence exhibited by the students based on their ability

to perform the computer task more quickly than in the first observation and with less uncertainly- no "how to" questions.

Interviews

Several recurring themes were noted: negative or recalcitrant attitudes about the subject of statistics, definitive feelings about the role of computer-assisted instruction as a teaching/learning aid, emphatic reactions regarding the purpose of the instructor as a source of encouragement and motivation, and positive responses about the effect of computer-assisted instruction on the dynamics of the class.

All three students interviewed commented on their initial feelings of fear about the subject. One student noted that she had a math phobia and disliked having to perform long computations, whereas the other student remarked that she did not like to do "math stuff." Student C reiterated her concerns about the amount of math that might be required for the class. When asked about his perception of students' general attitudes regarding statistics, the instructor of the course hypothesized that when students enter his class their initial reactions are: " I'm (sic) only here because someone held a gun to my head and I can't graduate without it."

Students' initial reactions about using the computer tool in the class were mixed. Student A noted that she has worked with computers and the presence of the computer tool for the statistics class did not intimidate her. Student C remarked that she looked forward to using the computer. Student B sounded more apprehensive. Part of her concern included her misgivings that the class would require math computation. She noted: "...now I had to learn something else besides the math stuff." The instructor recognizes that many students in his class have reservations, both about the subject matter as noted earlier, and also about the presence of the computer as a learning tool.

He stated: "But even today some of that residual fear is still present. You couple that with the idea that we are going to be doing the statistics on the computer and that is like a double-life sentence for most people."

Attitudes about statistics, even with the help of computer-assisted instruction did not vary much from pre-existing perceptions about the subject. Student A admitted that she does not like the subject of statistics, even with the help of computer-assisted instruction. Student C succinctly stated that she does not like studying statistics, and Student B noted: "With the help of the program, it is bearable."

Reactions to the use of the computer tool as a learning device were very positive for all those interviewed. Student A commented:

> I think it increased the motivation because I knew that the computer was doing the mathematical formulations so that the manipulation of the information became more fun since I wasn't doing the math. That's the way I used to have to do stats, pages and pages of computations. So I thought the computer made it a lot more interesting. You knew the accuracy was there.

Student A also noted that she is a visual learner and being able to manipulate the numbers helped her to understand the topic better. Student B affirmed that the visual nature of the program helped in her ability to understand statistical analysis for the reason that repetition of the statistical steps reinforced the concept taught. Student C added that the use of the computer as a tool was fun. The instructor reiterated the sentiments echoed by the students:

> Just the sheer quantity of encounters with doing analyses is so much greater than the others. That students can work on their own is a big benefit. Students

are more likely to use the computer-assisted program. I have a gut feeling that students learn more with this program. I also have some examples. I have students who recognize principles more because when I mention principles in my research class, the students who have used the computer groan. I know that this is good-natured, but I also know that they have prior recollection whereas students who did not use a computer tool seem not to recall as much.

When the students were asked that if they would choose to take another course that included computer-assisted instruction, the reactions were all favorable. They did not pause to reflect on this question; they nodded their heads vigorously, and even smiled. The instructor noted that there usually is a residual effect to learning statistics with the help of computer-assisted instruction. In reflecting back to previous classes, the instructor observed: "And I suspect that some of them might have even used the computer tool to supplement papers and materials for their other courses."

Reactions to disadvantages of computer-assisted instruction were inconsistent. Student A reflected on this question for a minute before responding. When she did respond with a simple, "No, I don't think so, " her tone of voice suggested uncertainty. Student B remarked that: "It's just something else that you have to learn so in the beginning it adds to your stress level." Student C commented on the possibility of the technology not working which would add to students' levels of frustration. The instructor also noted possible problems regarding technical aspects. He mentioned that some of his concerns are whether students will have access to a classroom so that each can sit at a terminal, if the program will work at each terminal, and will the instructor be comfortable with the program in order to use it as a teaching tool.

The role of the instructor prompted a flurry of similar responses. Student A commented: "Well I think it keeps the instructor focussed too because everything is right there. He could not deviate too much from what is planned." When asked how the student might feel if the computer-assisted tool was a program designed to provide feedback regarding accuracy of answers, Student A remarked:

> "I think that would have been compromised more, minimized. Because I think that what the instructor did was...first to give us feedback. He did not always just say right-wrong. He would point us in the direction of looking at it again. He stretched us to think a bit more than just to say that was right or wrong. So, I think he was trying to get us to understand the math tool but to really understand and think about the analysis. That's where his role was pivotal.

Student B's response to the question about the role of the instructor centered on methodology. She said:

> He needs to know that program real well! He can't just lecture from some book because he had to show us how to work the program. I think he knows the program really well. He seems comfortable showing us. Maybe, he has to be more aware of what we think. I mean, he couldn't just show us and be done with it. He never knows how quick we will catch on. For some stuff, it might take us longer to understand and that would eat up some class time. So, I think there is some uncertainty as to how much is covered in a class period.

Student C repeated the instructor's need to be familiar with the program and added that "maybe it was also fun for him to play with the computer so that he did not have to lecture."

broader examination of how the software changed the content and context of student learning. This study looked at three major research questions:

1. Will a computer-assisted tool influence students' attitudes about the subject matter?
2. What will be the outcome of computer-assisted instruction on the learning process?
3. How does the use of computer-assisted instruction affect the dynamics of the classroom both in terms of teaching methodology and student interaction?

With these goals in mind, the following conclusions were noted based on the two observations, and the interviews.

At first, the students seemed hesitant not only about the subject matter, but also about the use of a computer program. There was a definite lack of engagement in the subject matter as evidenced in the first observation. Based on their behavior, students appeared to be somewhat uncomfortable, unwilling, and or unmotivated. Now whether this lack of motivation stems from a possibility of having a certain math phobia, the dislike of having to take any type of a "math" class, or a distaste for working with a computer-assisted program, that information was not clear based on the observations alone.

The interviews with the students did seem to reinforce the observation results of the students' general dislike of the subject, regardless of the presence of the computer-assisted tool. All three students admitted that they did not want to study statistics. When asked how they felt about the computer program, the students remarked that they did not perceive it as threatening; rather two of the three women interviewed welcomed it. For them, the computer program suggested that they would not have to perform the math by hand.

Since a math phobia is considered a gender-specific response, it would be interesting to further investigate this possible relation by interviewing the males in the class. Would the men be as intimated studying statistics, as the women seemed to be? Would the men equally welcome the use of the computer-assisted program?

During the second observation, it seemed that once the students knew how to use the computer program with their assignments, there seemed to be more positive energy directed to the task and less negative energy regarding their lack of ability. A higher level of engagement with the subject matter was suggested. It is not possible to ascertain a specific causal relationship. In other words, it is not clear whether this engagement developed from the students' comfort level with the subject, the familiarity with the instructor's teaching style, the opportunity to learn the program in a non-threatening trial and error method, the ability to collaborate with their peers, and/or the ease in which they were able to apply a statistical measure to a problem with the computer program. What is clear is that the results from the interviews seem to highlight the importance of both the computer program and the instructor.

The students were positive about the role of the computer tool in the learning process. They stated that it helped them to visualize the process of performing statistical calculations, and that it made the learning experience more entertaining. The students remarked that they would be willing to take another similar course if it included computer-assisted instruction. The instructor summarized clearly the reactions of his students when he noted that once the students realize that the computer does not require math and that it can visualize for them how statistics are computed, students tend to be more eager to learn. These results seem to affirm conclusions from previous

studies (Campbell, 1984; Ferrell, 1986) that the use of computers in the classroom increases student motivation and interest.

Although the students seemed to look favorably upon the use of the computer-assisted program, they were equally adamant about the importance of the role of the instructor in their learning process. The interviewees perceive that the instructor plays a major role as an encourager, as a catalyst who motivates the students to keep trying to understand statistical concepts. When they were asked if they might prefer to simply have the computer provide feedback regarding the accuracy of their work, the students stated that they wanted and needed the encouragement and direction from the instructor. Consequently, this preliminary, limited study appears to substantiate Clark's (1983) assertions that the medium is not the message, and that the benefits attributed to previous research to computers can be explained by the teaching methods they support.

A pattern from this study which seems to contradict earlier findings is that when computer-assisted technology is used in the classroom, the teachers see themselves as facilitators of learning rather than authority figures whose job is it to impart knowledge (Bracey, 1988). The results from the interview with the instructor from this study suggest the opposite. This instructor takes an active role in the dissemination of information. Perhaps a possible explanation for this phenomenon is the fact that the computer-assisted program used for the introductory statistics course is not designated as a tutor that provides feedback regarding the accuracy of responses. Instead the computer-assisted program is a tool; a program that depends on ancillary assistance.

Regarding the computer-assisted program, several positive conclusions can be made. It is a tool for application and integration. Based on his meta-analytic research of computer-based programs and their effects on student learning, Kulick (1994) states that students tend to learn

more with the help of computer-based instruction. The students interviewed commented on how the program did help them to better understand statistics. Once student remarked that since she is a visual learner, the computer-assisted program in an invaluable tool.

Regarding the impact the computer-assisted program had on the dynamics of the classroom, it was fairly obvious that some type of change had occurred between the first and second observation. During the second observation students were more engaged not only with the subject matter but also with each other. . Student A remarked that "it would have been easy for each student to feel isolated, working alone on a problem with the help of the computer. Instead, students seem to want to help each other more." This finding is not unusual. There is a growing consensus that the use of computers for instruction typically increases interaction among students (Carney, 1986; Dickinson, 1986). A number of studies report more task-related talk among students when computers were present than otherwise (Bialo & Sivin, 1990; Podmore, 1991). These findings suggest that this interaction is potentially an important vehicle for learning rather than a distraction from it.

Ideally, it would be advantageous to observe this class a few more times during the semester so that a running description of the chronology of events could produce further evidence of the impact of a computer-assisted program on student learning and the instructor's role. Comparisons of this class to other classes with similar computer-assisted programs would add another level in triangulation so that "...the naturalist's alternative trustworthiness criteria may be operationalized" (Lincoln & Guba, 1985, p. 301).

Finally, Schofield (1995) emphasizes that the influence of any particular technology on teachers and students may depend on a wide variety of contextual factors that shape the way the

technology is used. She adds that the effects of integrating computer technology in education may be connected to perceived changes in the social functioning of the classroom or in combination with changes tied more closely to the technology itself. What is needed is more theoretical work delineating how subject-matter learning and classroom social processes are likely to be influenced by the integration of computer-assisted programs in the classroom.

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